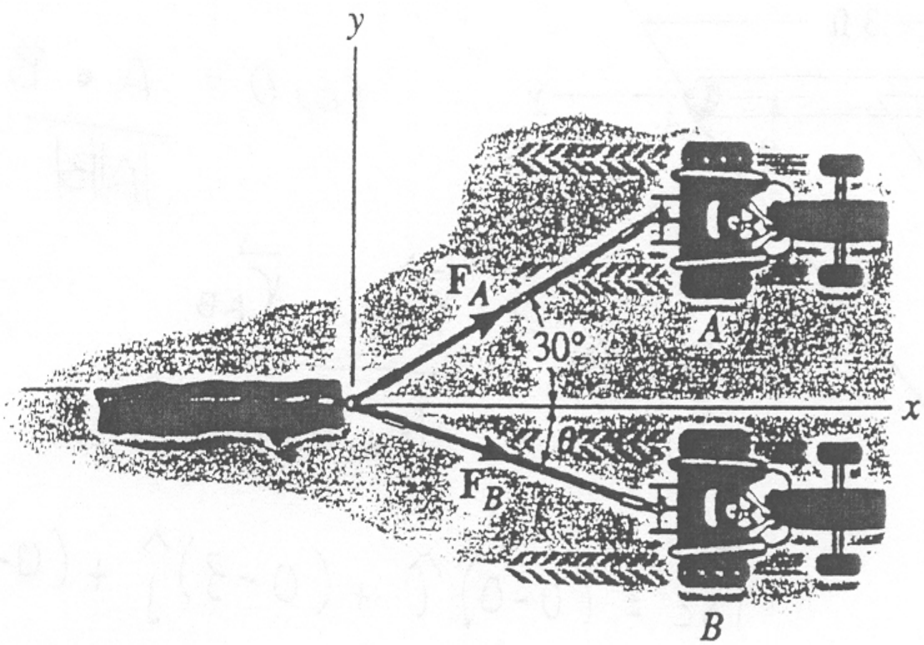
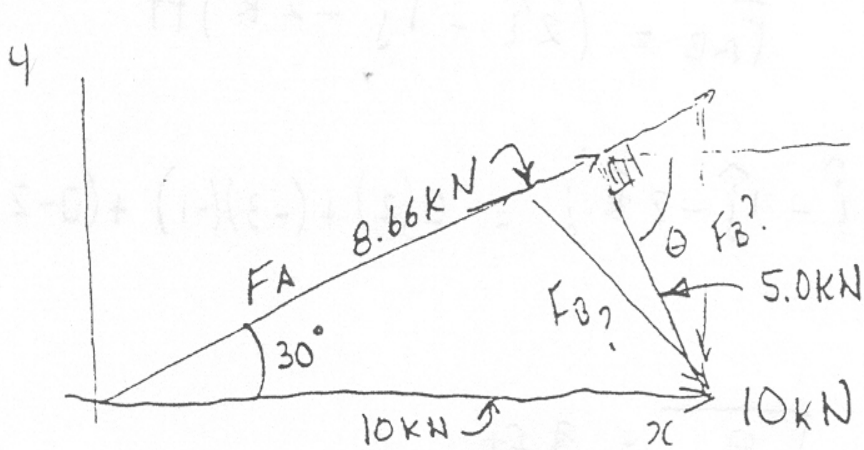
1) If the resultant, $\mathbf{F_R}$, of the two forces acting on the log is to be directed along the positive x axis and have a magnitude of 10 kN, determine the angle θ of the cable attached to B such that the force $\mathbf{F_B}$ in this cable is minimum. What is the magnitude of the force in each cable for this situation?





By inspection for the 10kN f

to have F_B minimum, F_B m

be $\perp F_A$.

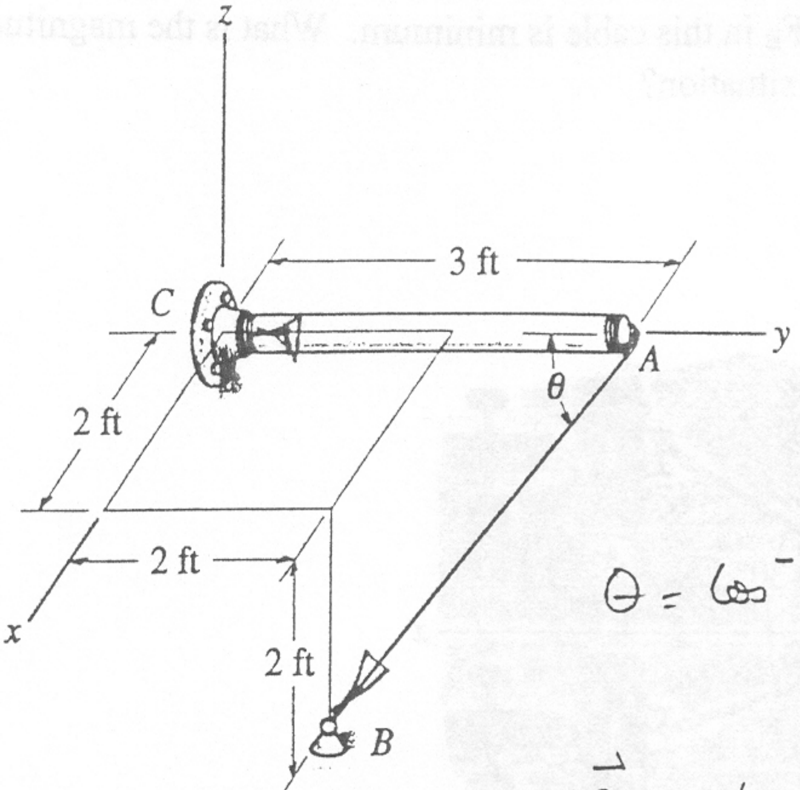
$\therefore \theta = 60°$ from Δ

$F_A = \cos 30° (10\,kN)$

$F_A = 8.66\ kN$ @ 3

$F_B = 5.00\ kN$ @ 6

2) Determine the angle θ between the y axis of the pole and the wire AB.



Install vectors $\vec{r}_{AC}$ & $\vec{r}_{AB}$

$$\vec{A} \cdot \vec{B} = |A||B| \cos\theta .$$

$$\cos\theta = \frac{A \cdot B}{|A||B|}$$

$$\theta = \cos^{-1} \frac{\vec{r}_{AC} \cdot \vec{r}_{AB}}{|r_{AC}||r_{AB}|}$$

$$\vec{r}_{AC} = (0-0)\hat{i} + (0-3)\hat{j} + (0-0)\hat{k} =$$

$$\vec{r}_{AB} = (2-0)\hat{i} + (2-3)\hat{j} + (-2-0)\hat{k}$$

$$\vec{r}_{AB} = (2\hat{i} - 1\hat{j} - 2\hat{k})\,ft$$

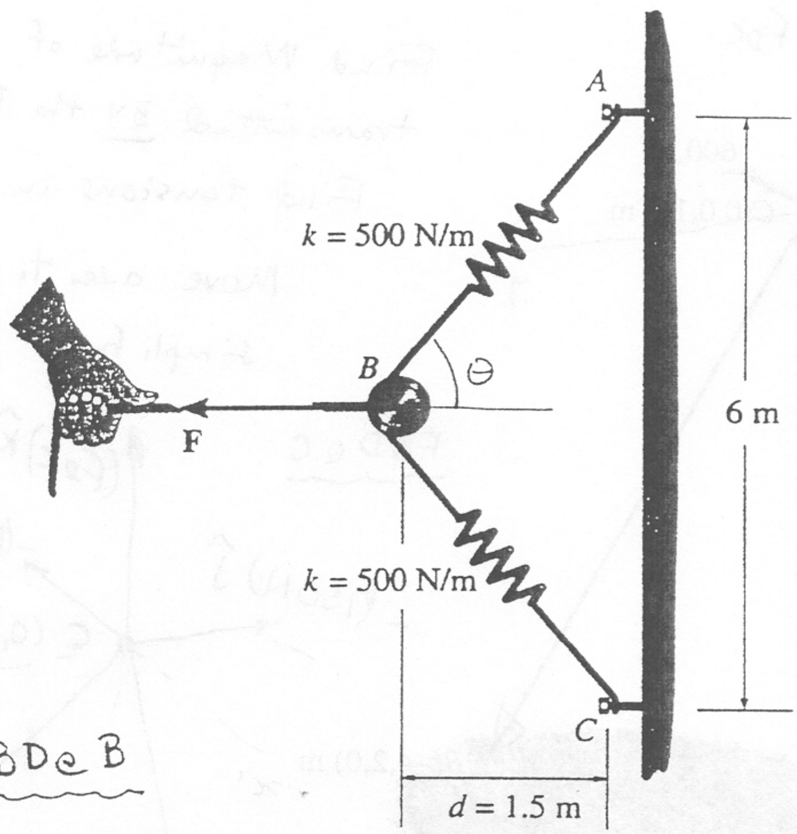
$$\vec{r}_{AC} \cdot \vec{r}_{AB} = (-3\hat{j}) \cdot (+2\hat{i} - 1\hat{j} - 2\hat{k}) = 0(2) + (-3)(-1) + (0 - 2) =$$

$$|r_{AC}| = 3 \text{ ft}$$

$$|r_{AB}| = \sqrt{2^2 + 1^2 + 2^2} = \sqrt{9} = 3 \text{ ft.}$$

So $\theta = \cos^{-1}\left(\frac{3}{3 \times 3}\right) = \cos^{-1}\left(\frac{1}{3}\right) = 70.5°$

3) The elastic cord (or spring) ABC has a stiffness of 500 N/m and an unstretched length of 6 m. Determine the horizontal force **F** applied to the cord, which is attached to the small pulley B, so that the displacement of the pulley from the supports is d = 1.5 m.



Find stretch in spri
Due to symmetry both si
will have the same for
$F_{BA} = F_{BC}$ *

$F_{BA} = K(\text{stretch}) = l_f - l_o$

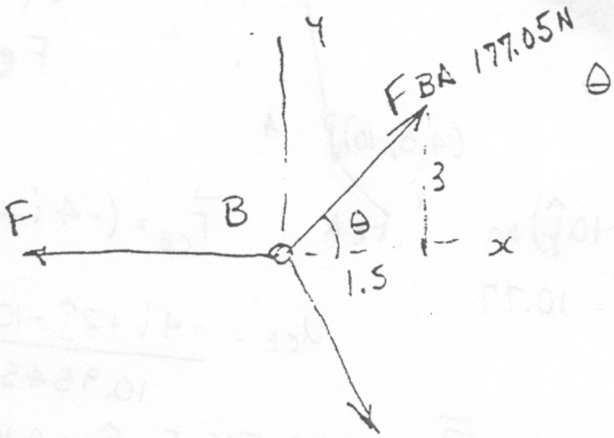
stretch AB $= \left(\sqrt{3^2+1.5^2} - 3\right)$

stretch AB = 0.3541 m

$\therefore F_{AB} = 500\frac{N}{m} \times 0.3541\,m$

$F_{AB} = \underline{177.05\ N}$

FBD @ B



$F_{BC} = 177.05$ N

$\theta = \tan^{-1}\left(\frac{3}{1.5}\right) = 63.43°$ Using Equilibrium

$\Sigma F_x = 0$ from symmetry *

$2(F_{BA}\cos 63.43°) - F = 0$

$F = 2(177.05)\cos 63.43° = 158.4$

Horizontal Force Req'd is $\underline{158.4\ N}$

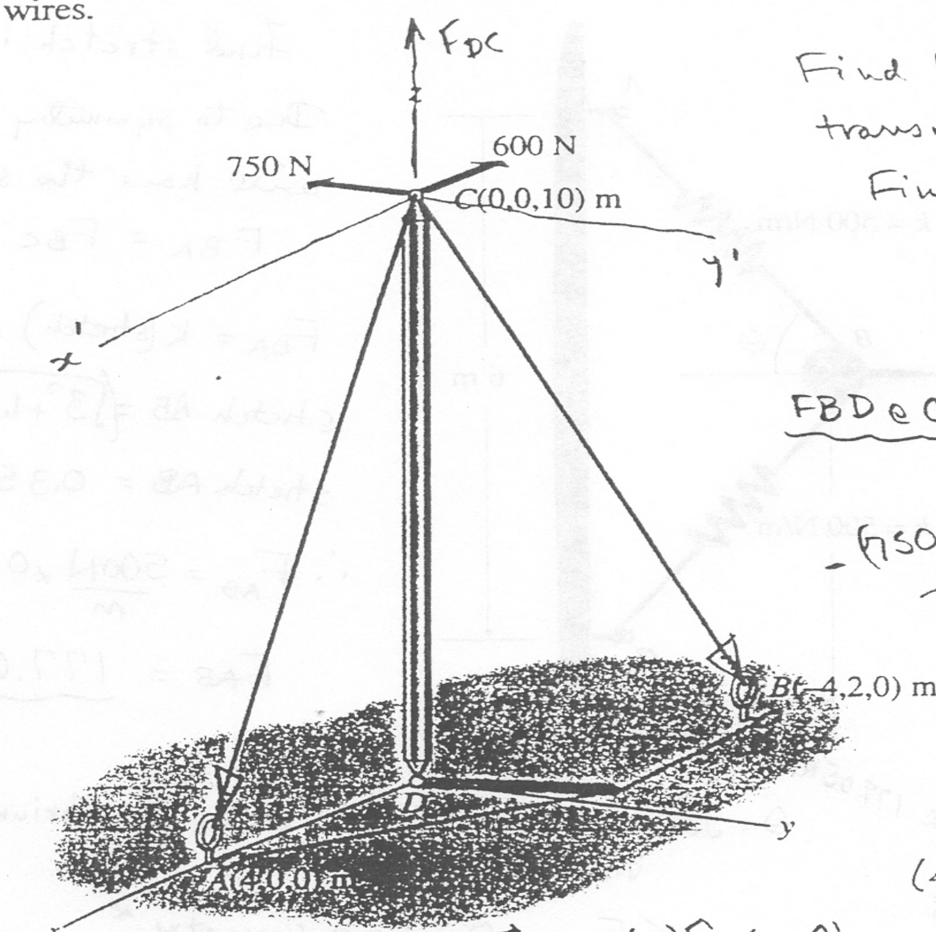
Doing it the other way

ABC stretches 2×0.3541 m

Now $F_{ABC} = 2 \times 0.3541 \times 500$

$F_{ABC} = 354.1$ N

4) Two forces are applied in a horizontal plane to a loading ring at the top of a post as shown. The post can transmit only an axial compressive force. Two guy wires AC and BC are used to hold the loading ring in equilibrium. Determine the magnitude of the force transmitted by the post and the magnitude of the tensions in the two guy wires.

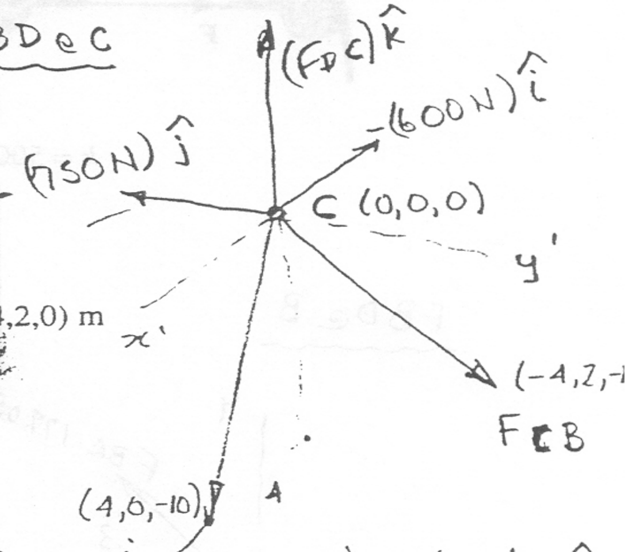


Find Magnitude of force transmitted BY the Post.

Find tensions in guy wires.

Move axes to C to simplify.

FBD @ C



$\vec{F}_{CA} = |F_{CA}| \dfrac{\vec{r}_{CA}}{|r_{CA}|} = F_{CA}\hat{u}_{CA}$ $\vec{r}_{CA} = (4)\hat{i} + (-10\hat{k})$ m $\vec{r}_{CB} = (-4i + 2\hat{j} -$

$r_{CA} = \sqrt{4^2 + 10^2} = 10.77$

$\hat{u}_{CB} = \dfrac{-4i + 2\hat{j} - 10\hat{k}}{10.9545}$

$\vec{F}_{CA} = F_{CA}\left(\dfrac{4\hat{i}}{10.77}\right) - \left(\dfrac{10}{10.77}\right)\hat{k}$

$\vec{F}_{CB} = -0.36515\, F_{CB}\hat{i} + 0.18257$
$-0.91287\, F_{CB}\hat{k}$

$\vec{F}_{CA} = 0.3714\, F_{CA}\hat{i} - 0.9285\, F_{CA}\hat{k}$

$\Sigma F_x = 0$; $\Sigma F_y = 0$; $\Sigma F_z = 0$ for equilibrium @ C.

$\Sigma\hat{k}:\ F_{DC}\cancel{\hat{k}} - 0.91287\, F_{CB}\cancel{\hat{k}} - 0.9285\, F_{CA}\hat{k}$

$0.3714\, F_{CA}\cancel{\hat{i}} - 0.36515\, F_{CB}\cancel{\hat{i}} - 600\,\hat{i}\,\text{N} = 0$ -- (1)

$+0.18257\, F_{CB}\hat{j} - 750\,\hat{j}\,\text{N} = 0$ (x2 and add) - (2)

$F_{DC} = 4107.6(0.91287) + 5654.3$

$F_{DC} = 8999.7$ or $\underline{9000\text{ N}}$

$0.3714\ \ F_{CA} - 2100\text{ N} = 0$

$F_{CA} = \dfrac{2100}{0.3714} = \underline{5{,}654.3\text{ N}}$

$F_{CB} = \underline{4{,}110\text{ N}}$ ← guy wir

$F_{CA} = \underline{5{,}650\text{ N}}$

Sub into (1)

$\dfrac{0.3714(5{,}654.3) - 600}{0.36515} = F_{CB}$; $\underline{F_{CB} = 4107.6\text{ N}}$